# The Role of the Industrial Alliance in the USA

*Joint Workshop on Industrial Alliances for IGCC & Co-Production and $CO_2$ Capture & Storage*

*Beijing, China*
*May 23-24, 2007*

**Thomas A. Sarkus, FutureGen Project Director**
**National Energy Technology Laboratory**

# National Energy Technology Laboratory

- **Only DOE national lab dedicated to fossil energy**
  - Fossil fuels provide 85% of U.S. energy supply
- **One lab, five locations, one management structure**
- **1,100 Federal and support-contractor employees**
- **Research spans fundamental science to technology demonstrations**

***Pennsylvania***

***Oregon***

***West Virginia***

***Alaska***

***Oklahoma***

# *Presentation Outline*

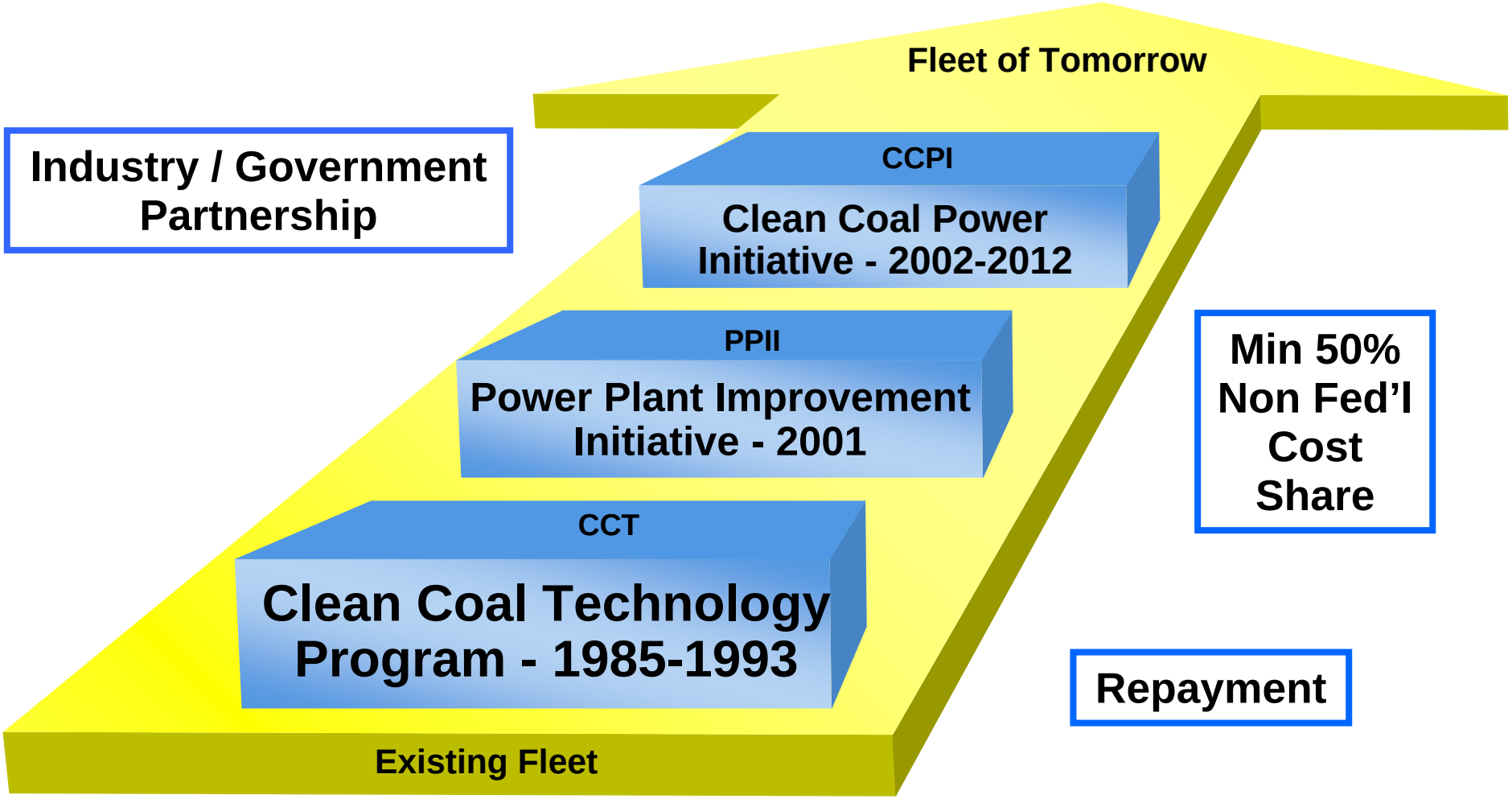
- **Part I: Clean Coal Demonstration Programs**
  - a) Clean Coal Technology (CCT) Program
  - b) Power Plant Improvement Initiative (PPII)
  - c) Clean Coal Power Initiative (CCPI)
- **Part II: FutureGen**
- **Part III: Observations & Discussion**

## *Part I: Clean Coal Demonstration Programs*

*a) Clean Coal Technology (CCT)*
*b) Power Plant Improvement Initiative (PPII)*
*c) Clean Coal Power Initiative (CCPI)*

# DOE's Coal Demonstration Programs

## *Implemented Through Competition*



# CCT Program Success Stories

## *Advanced Pollution Controls*

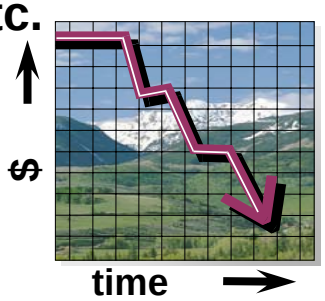
- Installed on 75% of U.S. coal plants
- 1/2 to 1/10 cost of older systems
- Billions saved in compliance costs

*FGD Scrubbers*

*Low-$NO_x$ Burners*

## *HAPS & Hg Data*

- Quantified HAPS Levels
- Basis for Hg R&D, regs, etc.




## *Advanced Coal Power Systems*

- 2 IGCC pioneers + 1 large-scale CFB

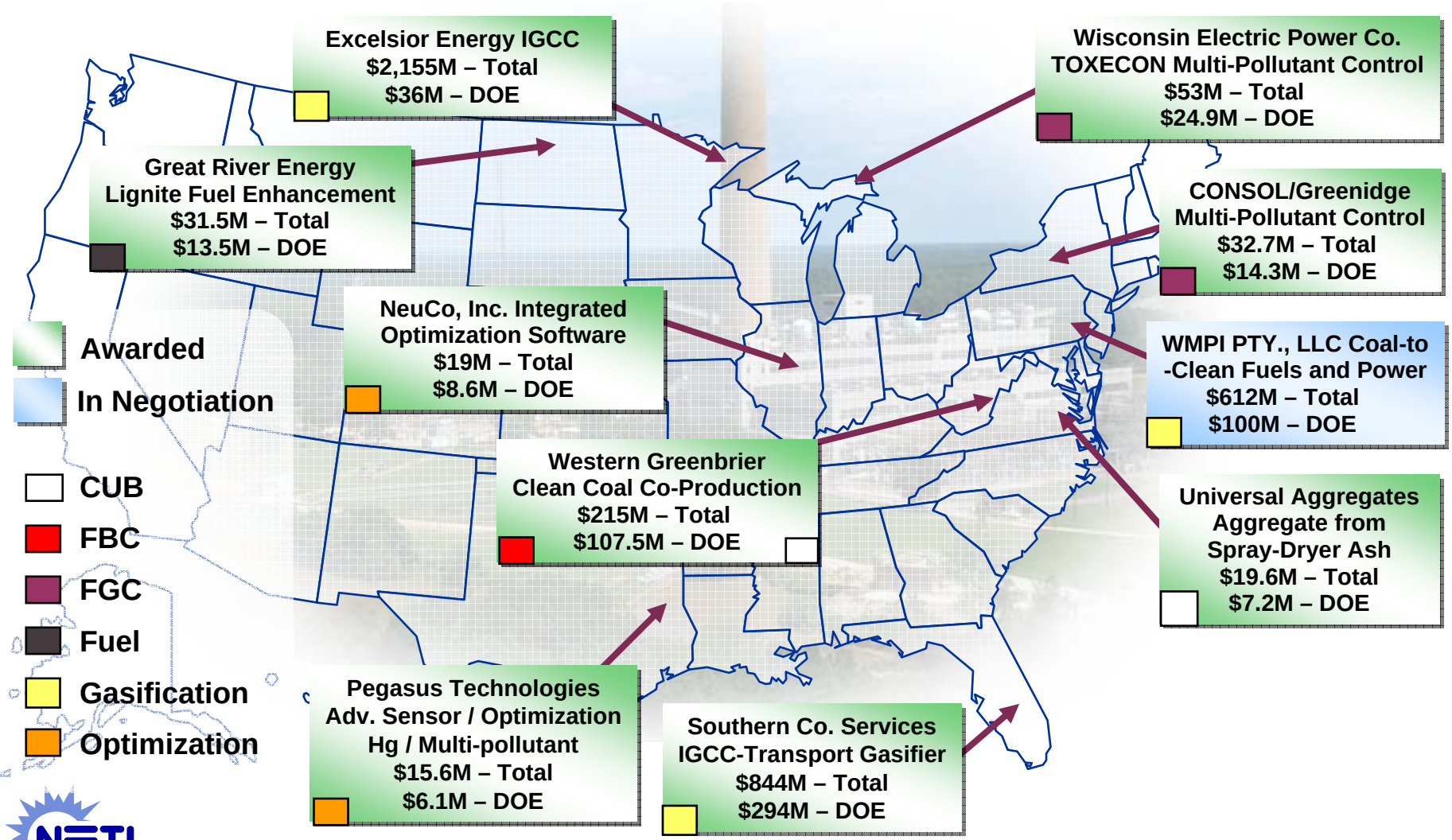
*JEA CFBC*

*Wabash IGCC*

*Tampa IGCC*

# Active CCPI & PPII Demonstration Projects

## *Locations and Cost Share*



# FY 2008 Budget Language

- **CCPI-3**
  - …targeting **systems that capture carbon dioxide for sequestration or beneficial reuse**, consistent with the program's GPRA Unit Program Goal 1.2.08.00 (Near-Zero Atmospheric Emissions Coal-Based Electricity and Hydrogen Production).
  - … using approximately $194 million of unobligated funds from projects that were selected, but not awarded, plus appropriations that have not yet been committed to projects, CCPI will complete the Round 3 solicitation, proposal evaluations, and **project selections to assemble the initial portfolio of advanced technology systems that capture carbon dioxide for sequestration and beneficial reuse.**

# CCPI Round 3 Funding / Schedule

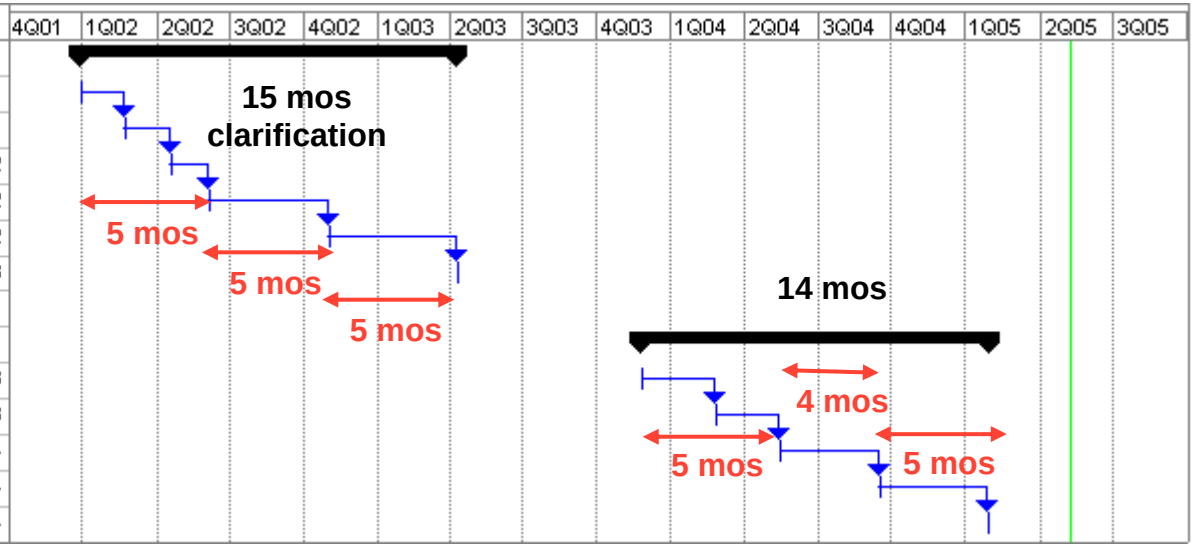
- **Constraints**
  - Selections cannot exceed available funding
  - At least $250 million is needed
  - Limited to carbon capture, sequestration & beneficial reuse
- **Funding**
  - Old money = $58 million
  - FY 2006 = $50 million
  - FY 2007 = $60 million
  - FY 2008 = $70 million
- **Timing**
  - Announce soon
  - Select projects by 3rd or 4th quarter FY08

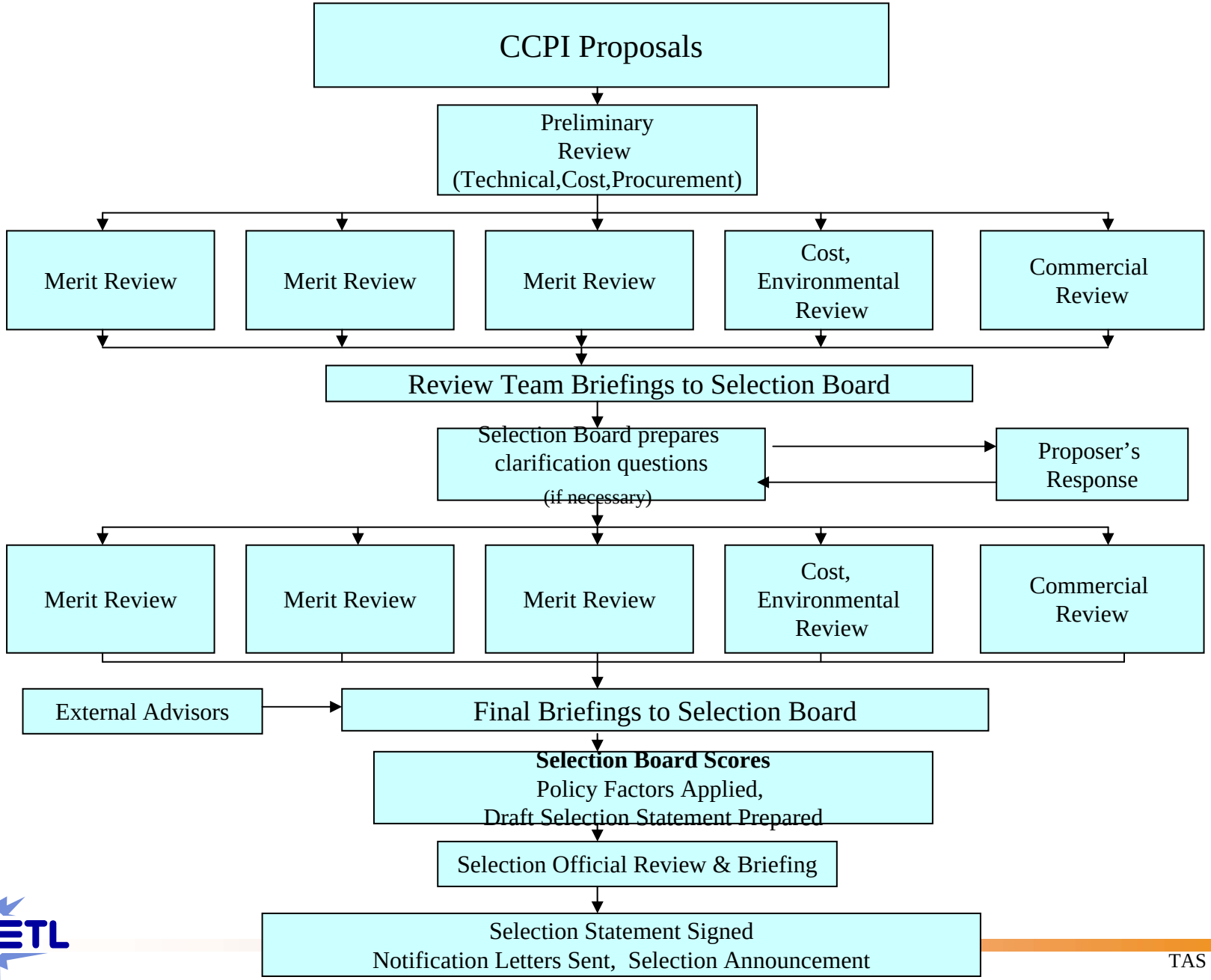
# CCPI Round 3 Funding / Schedule

## History

(shown by fiscal year)

| ID | Task Name | Start |
|---|---|---|
| 1 | **Round 1** | **Fri 9/28/01** |
| 2 | Workshop | Fri 9/28/01 |
| 3 | PreSolicitation | Tue 11/20/01 |
| 4 | Draft Solicitation | Thu 1/17/02 |
| 5 | Final Solicitation | Mon 3/4/02 |
| 6 | Proposals Due | Thu 8/1/02 |
| 7 | Announce Selection | Wed 1/8/03 |
| 8 | | |
| 9 | **Round 2** | **Tue 8/26/03** |
| 10 | Workshop | Tue 8/26/03 |
| 11 | Draft Solicitation | Wed 11/26/03 |
| 12 | Final Solicitation | Fri 2/13/04 |
| 13 | Proposals Due | Tue 6/15/04 |
| 14 | Announce Selection | Thu 10/28/04 |



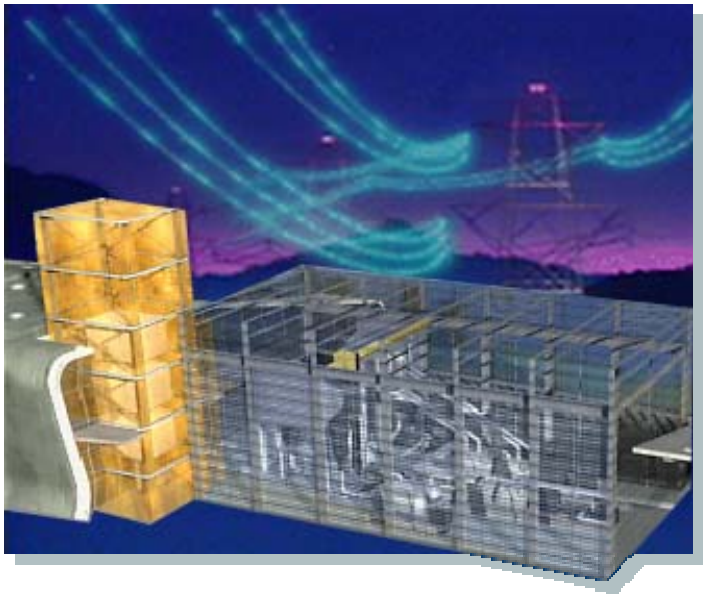

CCPI Proposals
Preliminary Review (Technical,Cost,Procurement)
Merit Review
Merit Review
Merit Review
Cost, Environmental Review
Commercial Review
Review Team Briefings to Selection Board
Selection Board prepares clarification questions (if necessary)
Proposer's Response
Merit Review
Merit Review
Merit Review
Cost, Environmental Review
Commercial Review
External Advisors
Final Briefings to Selection Board
Selection Board Scores
Policy Factors Applied,
Draft Selection Statement Prepared
Selection Official Review & Briefing
Selection Statement Signed
Notification Letters Sent, Selection Announcement

# *Part II: FutureGen*

# *FutureGen* Objectives

**Revolutionary near zero-emission, coal-based power plant to:**

- **Co-produce hydrogen & electricity from coal**
- **Emit virtually no air pollutants**
- **Capture & permanently sequester carbon dioxide**
- **Integrate operations at full-scale – a key step**



# *FutureGen:* Technology Challenges

- **Establish technical, economic & environmental viability of "zero-emission" coal plants by 2015; thus, creating the option for multiple commercial deployments by 2020**
- **Validate DOE goals (ref. Report to Congress, dated March 2004):**
  - **Sequester >90% $CO_2$ with potential for ~100%**
  - **>99% sulfur removal**
  - **<0.05 lb/MMBtu NOx**
  - **<0.005 lb/MMBtu PM**
  - **>90% Hg removal**
  - **With potential for an $N^{th}$ plant commercial cost no more than 10% greater than that of a power plant without sequestration**
- **Prototype coal-based power plant of the future**

# *FutureGen*: Integrating R&D Products

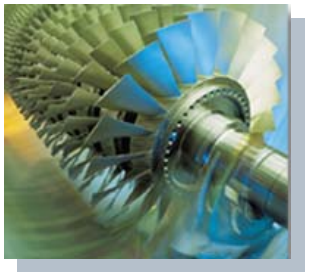
Fuel Cells

FutureGen

Carbon Sequestration

Gasification with Cleanup & Separation

$H_2$ Production



Optimized Turbines

System Integration

# FutureGen Project

## *Supporting FutureGen is a Major Goal of the R&D Programs*

- **A $1.5 billion coal-based, near zero-emissions electricity plant with carbon capture & storage**
- **12-year government-industry partnership**
  - Signed Cooperative Agreement with DOE on Dec. 2, 2005
  - Project structuring to Jan. 2007
  - Proceeded from Budget Period 0 (Conceptual Design) to Budget Period 1 (Preliminary Design) on March 23, 2007
  - Design to March 2009
  - Construction to July 2012
  - Operations to November 2015
  - Site monitoring to November 2017
- **Industry will design, build & operate FutureGen**
  - With Gov't oversight & International participation

# *FutureGen* Will Build Upon Experience from Commercial-Scale Coal-Based IGCC Power Plants

## Wabash River

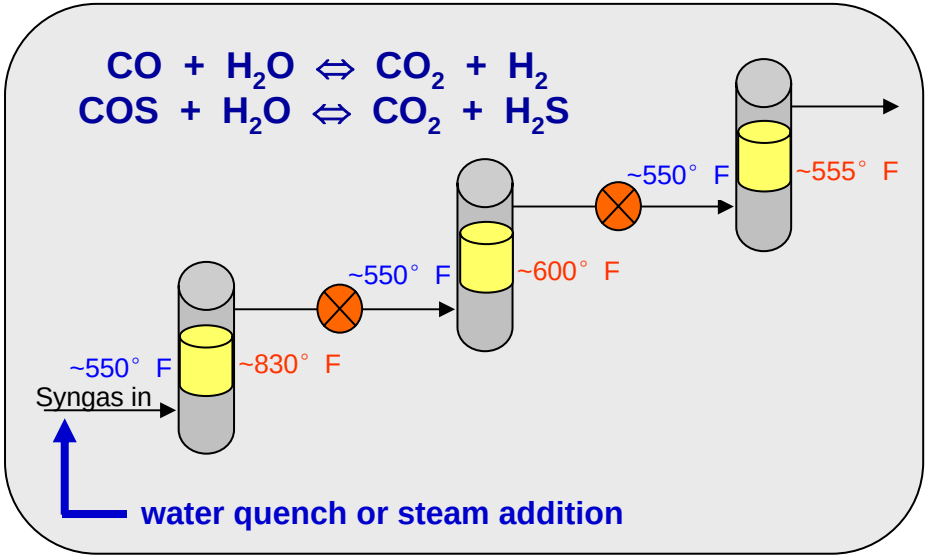
- W. Terre Haute, IN
- Operations began 11/95
- 1996 Powerplant Award
- 296 MWe (gross); 262 MWe (net)

## Tampa Electric

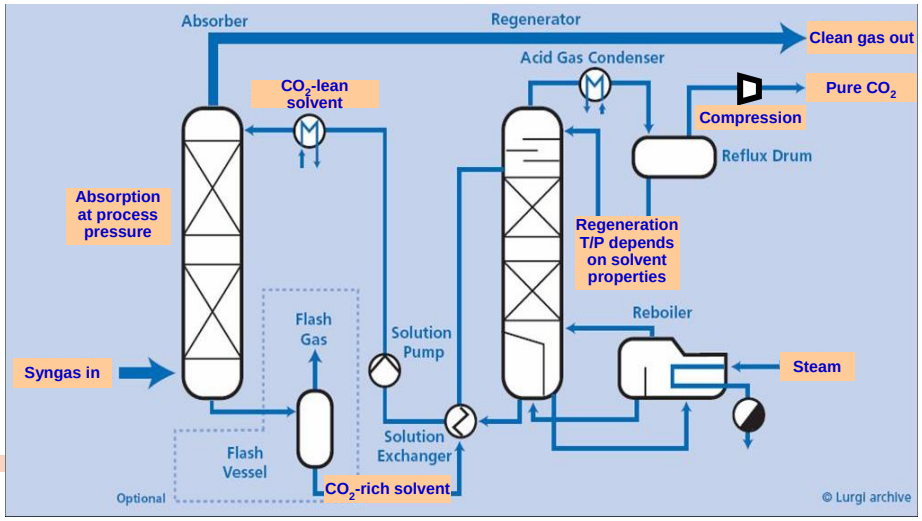
- Mulberry, FL
- Operations began 9/96
- 1997 Powerplant Award
- 315 MWe (gross); 250 MWe (net)

# Other Required Process Operations

- **Water Gas Shift Reactors**
  - Convert CO in syngas to $CO_2$ & $H_2$




- **Carbon Separation Equipment**
  - Remove $CO_2$ & $H_2S$ from $H_2$

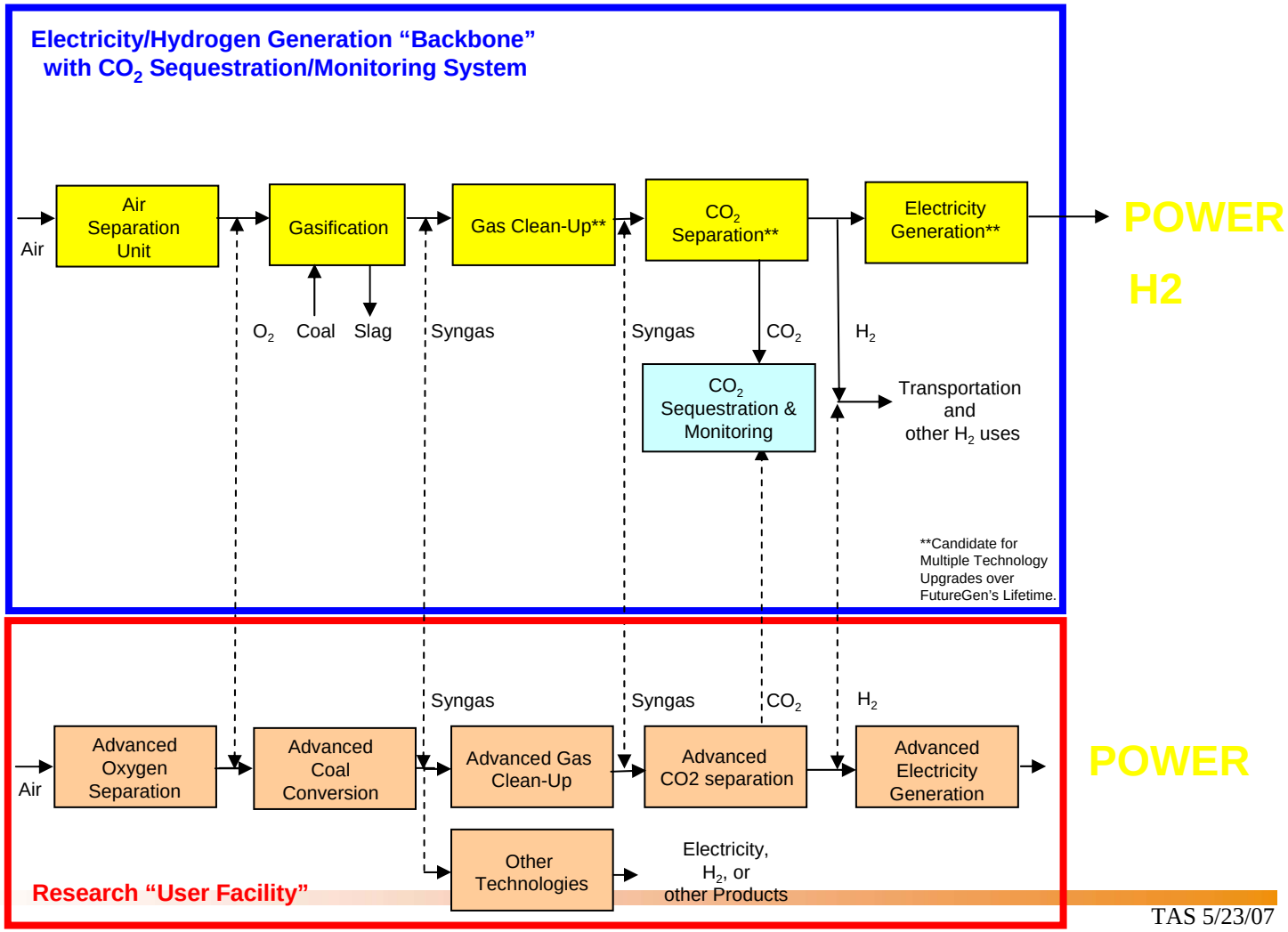


# *FutureGen:*
# Process Features

**Full-Scale Gasification Research Platform**

**Sequestration**

**Sub-scale Research User Facility**



# *FutureGen* Will Build on Two Non-Integrated One Million TPY $CO_2$ Sequestration Projects

### *Weyburn $CO_2$ EOR Project*

- Pan Canadian Resources
- 200-mile $CO_2$ pipeline from Dakota Gasification Plant
- Enhanced Oil Recovery in Canada over 20 years

### *Sleipner North Sea Project*

- Statoil
- $CO_2$ sequestered (1996-2000)
- Currently monitoring $CO_2$ migration
- Separates $CO_2$ from natural gas
- $36–50 / tonne $CO_2$ tax

# *FutureGen* Industrial Alliance, Inc.
## Signed Cooperative Agreement with DOE on Dec. 2, 2005

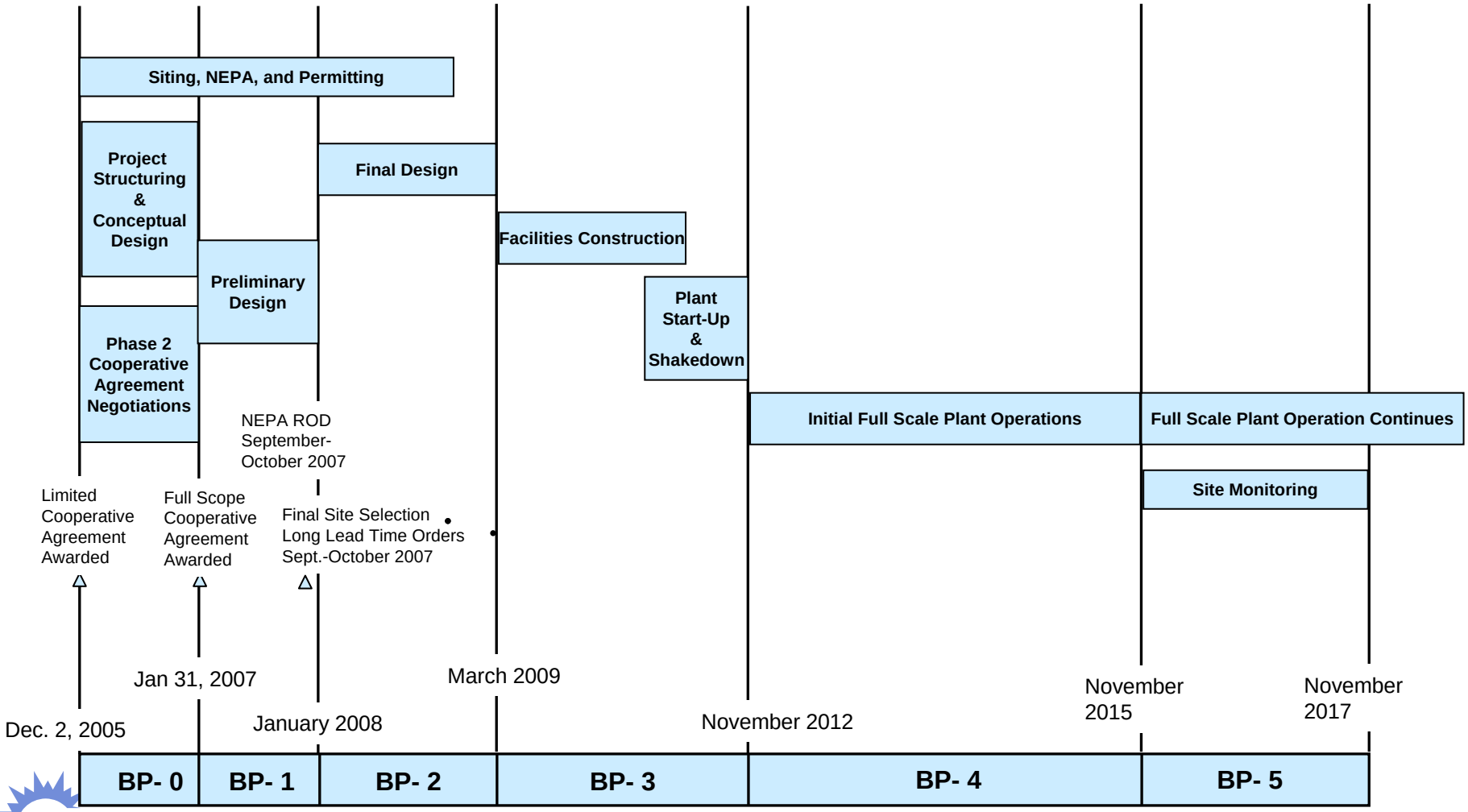
- American Electric Power
- AngloAmerican
- BHP Billiton
- China Huaneng Group
- CONSOL Energy
- E.ON U.S.
- Foundation Coal
- Peabody Energy
- PPL
- Rio Tinto Energy America
- Southern Company
- Xstrata Coal

# *FutureGen* Industrial Alliance

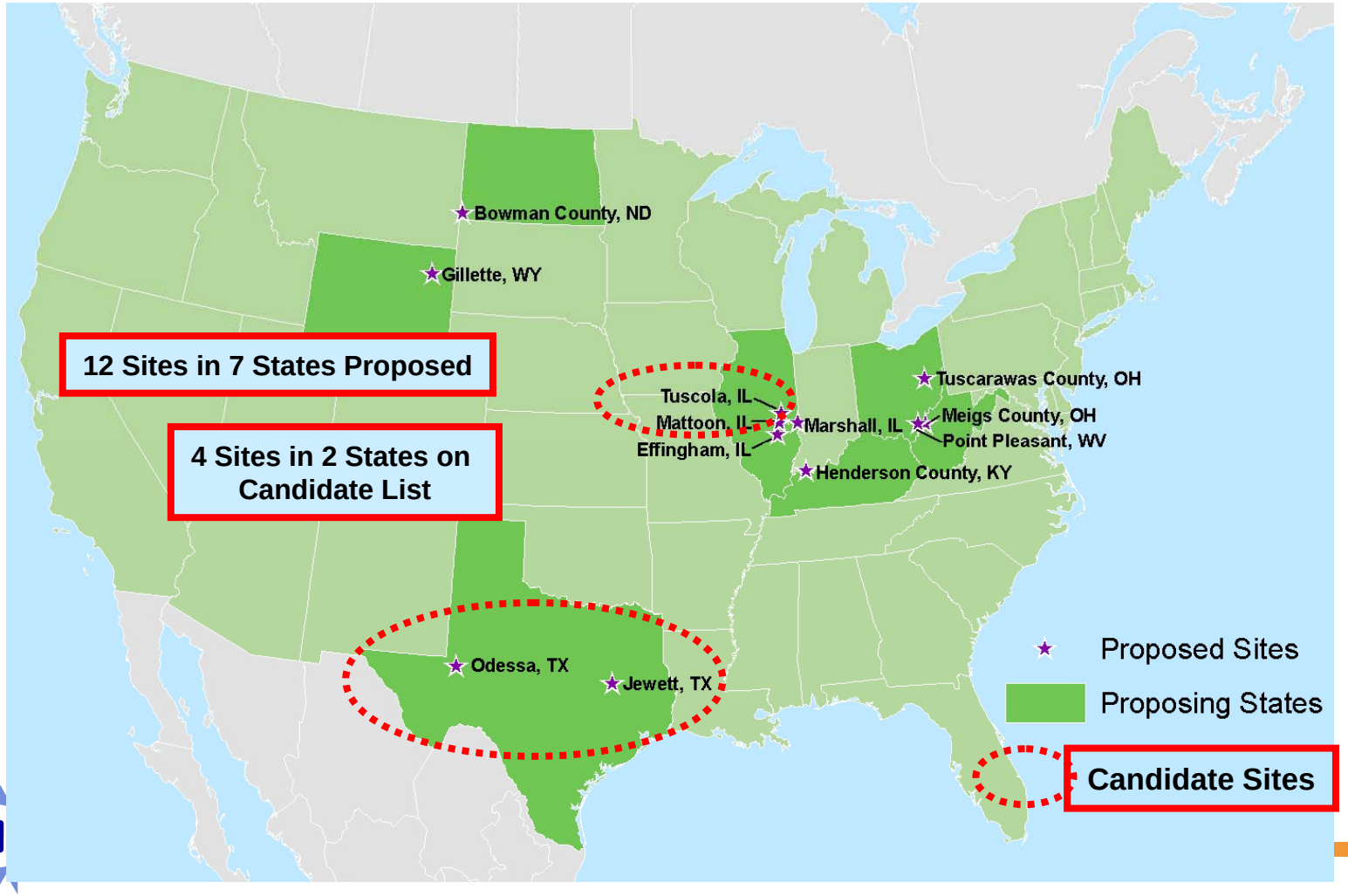
| *Company* | *Global Rank* | *Country* | *Sales ($MM)* |
|---|---|---|---|
| AEP | 363 | U.S.A. | 12,622 |
| AngloAmerican | 119 | U.K. | 33,072 |
| BHP Billiton | 97 | Australia | 31,850 |
| CONSOL Energy | 1251 | U.S.A. | 3,715 |
| E.ON | 47 | Germany | 80,534 |
| Foundation Coal | -- | U.S.A. | 1,470 |
| Huaneng Power | 784 | China | 4,966 |
| Peabody Energy | 834 | U.S.A. | 5,256 |
| PPL | 556 | U.S.A. | 6,899 |
| Rio Tinto | 151 | U.K. | 22,465 |
| Southern Co. | 268 | U.S.A. | 14,356 |
| Xstrata | 203 | Switzerland | 18,572 |

*Sources: Forbes Global 2000 List, 4/16/2007*
*& Hoovers.com (for Foundation Coal)*

# *FutureGen* Project Schedule



# *FutureGen*: Site Selection



# Candidate Site Features

## *Conceptual Sequestration Design*

### Mattoon

- Injection on-site
- ~8,000 ft deep
- Mt. Simon sandstone formation

### Tuscola

- Injection off-site (~10 miles)
- New pipeline to be constructed
- ~8,000 ft deep
- Mt. Simon sandstone formation

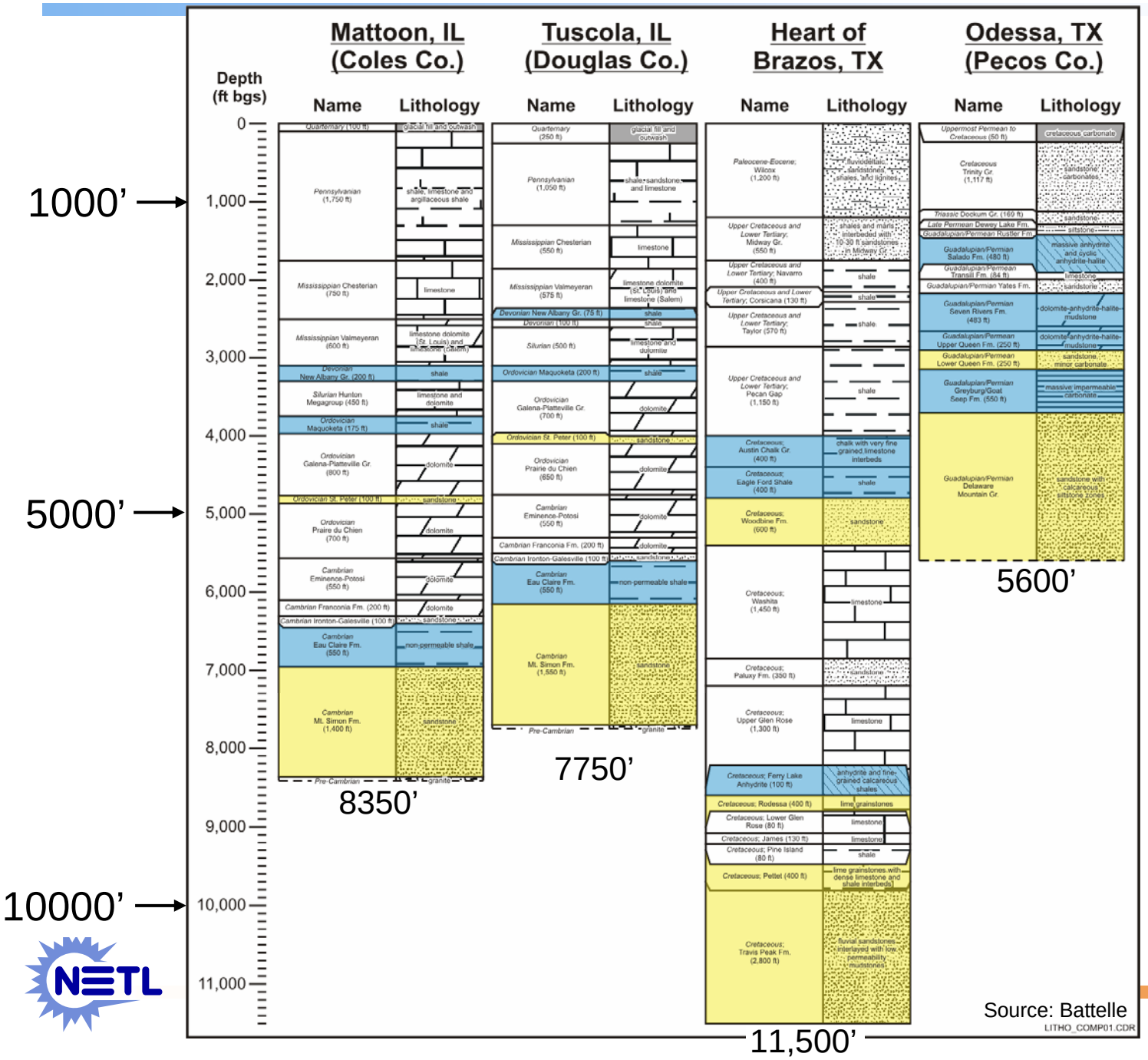
### Brazos

- Injection at two sites (~25 and 33 miles)
- New pipeline to be constructed
- ~6,000 ft deep in the Woodbine formation
- ~11,000 ft deep in the Travis Peak formation

### Odessa

- Injection off-site (~56 miles)
- Potential to use existing pipeline with minor upgrades
- ~6,000 ft deep
- Guadeloupe Sands

# Comparison of Sites by Depth




Seal

Injection

TAS 5/23/07

# *FutureGen*: Current Activities

- **Site Selection**
  - **"Final Four" were announced on July 25, 2006**
  - **Environmental Impact Statement now being prepared**
  - **Final site to be announced by November 2007**

- **Conceptual Design Complete**
  - **Reviews with major technology suppliers**
  - **Reservoir modeling for each site**
  - **Conceptual design & cost estimate**

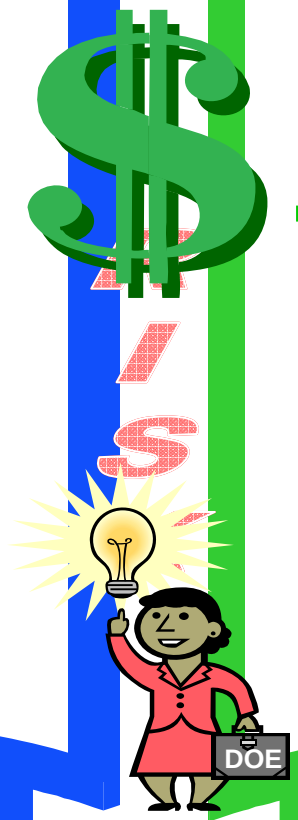
- **Preliminary Design Now In Progress**
  - **Engineering & Construction Management (ECM) subcontract**
  - **ECM subcontractor to prepare technology/equipment RFP packages**
  - **Technology/equipment RFP mid-2007; selections late-2007/early 2008**

# *Part III: Observations & Discussion*

# Perception: A Hurdle To New Technology Coal Plants

**Developers Are From Pluto**

- Advanced
- New
- Innovative




**Lenders Are From The Sun**

- Untested
- Experimental
- Uncertain

# Government Role

- **Technology Advancement**
  - Establish Program Goals
  - Issue RFP, Evaluate & Select Proposals
  - Technical Oversight of Selected Projects

- **Co-Funding** (Financial Assistance, not Acquisition)
  - 80% Maximum for R&D Projects
  - 50% Maximum for Demonstration Projects
  - Other incentives (e.g., tax credits, loan guarantees)

- **Technology Transfer**
  - Ensure Broader Applicability of Project
  - Disseminate Basic, Non-Proprietary Information

# Industry Role

- **Submit Qualifying Proposals**
  - Technology Advancement
  - Host Site, Equipment Suppliers, Engineering, etc.
- **Co-Funding**
  - 20% Minimum for R&D Projects
  - 50% Minimum for Demonstration Projects
- **Own, Design, Build & Operate Facility**
  - Facility Disposal, If Necessary
- **Subsequent Commercialization** (& Repayment)

# Visit Our Websites

***Office of Fossil Energy's website:***
**www.fe.doe.gov**

***NETL's website:***
**www.netl.doe.gov**

# Thank You for Your Kind Attention!

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